

Memorandum

U.S. Department of Transportation
Federal Aviation Administration

Subject:	ACTION: Engine Overtemperature Test; Governing Temperature Location	Date:	10-7-97
From:	Manager, Engine and Propeller Directorate Standards Staff, ANE-110	Reply to Attn. of:	Mark Rumizen, ANE-110: (781) 238- 7164
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1. INTRODUCTION

The Engine and Propeller Directorate was recently requested to provide written guidance regarding the governing engine temperature location for the engine overtemperature test of Federal Aviation Regulation (FAR) 33.88. This memo establishes a standardized policy for Aircraft Certification Offices (ACOs) to ensure consistent application of the requirements of FAR 33.88. Applicants engaged in turbine engine

certification programs should be advised of this policy to ensure consistent application of the overtemperature test requirement.

2. BACKGROUND

Many operational factors or systems failures can produce engine overtemperature conditions in-flight. Therefore, engine certification regulations require that applicants must substantiate by test the ability of each turbine rotor and each engine to withstand overtemperature conditions while still providing the ability to continue flight in order to accomplish an emergency landing. The time intervals and temperature levels for that engine test have evolved based on industry experience in estimating crew response time and turbine engine cycle characteristics.

The FAA regulations governing general operating rules for aircraft allow the pilot, in an emergency situation, to deviate from any operating rule to meet that emergency (see FAR 91.3(b)) and 91.9(a.) This rule allows a pilot, when in need of additional power to save the aircraft, to exceed the redline temperature of an engine. In addition, control system or other engine failures can produce engine overtemperature conditions. Engine airworthiness regulations were therefore established to substantiate the turbine rotor's and engine's ability to withstand overtemperature conditions and still land safely. Time intervals and temperature levels for the test have evolved based on flight crew response time and turbine engine cycle characteristics.

The initial engine airworthiness requirement to substantiate overtemperature capability was established in Civil Air Regulation (CAR) 13.216 (a), "Turbine Rotors". This regulation specified that turbine rotors must demonstrate a sufficient strength margin to withstand abnormal operating temperature. The overtemperature requirement was not included in the initial issuance of FAR 33 in 1965, but was reintroduced in Amendment 6 to FAR 33 in 1974. Similar to the original CAR rule, this version required that the applicant demonstrate turbine rotor strength margin when exposed to abnormal temperatures. However, it was now a Block Test as opposed to a Design Consideration, and a specific test duration (30 minutes) and temperature (75°F higher than the maximum limit) were provided. Amendment 10, in 1984, reduced the test duration to 5 minutes and re-established the objective of the test as a demonstration of the ability of the engine to withstand an in-service overtemperature event, as opposed to a demonstration of the turbine rotor strength margins. The last revision to this rule occurred in Amendment 18, in 1996, and added overtemperature test requirements for One-Engine Inoperative (OEI) ratings. Throughout all of the changes to this rule, a governing temperature location from which to base the 75°F increase was never specifically defined in the rule. However, AC 33.2B, Paragraph 59(a) does distinguish TIT as the critical parameter when providing guidance for the engine overtemperature test. This resulted in inconsistent application of the rule by the FAA, in which various temperatures such as turbine inlet temperature (TIT), inter-turbine temperature (ITT), or exhaust gas temperature (EGT) were used by applicants as the governing temperature location.

3. GOVERNING TEMPERATURE LOCATION

FAR 33.88 (a) currently requires that "each engine must run for 5 minutes at maximum permissible rpm with the gas temperature at least 75°F (42°C) higher than the maximum steady-state operating limit...". FARs 33.88 (b) and (c) address the OEI rated engines but contain similar language relative to the test temperature. As discussed above, the rule does not specify a governing temperature location from which to base the test temperature increase. FAA certification experience consists of overtemperature testing at various governing temperature locations, such as Turbine Inlet Temperature (TIT), Inter-turbine Temperature (ITT), or Exhaust Gas Temperature (EGT). Application of the 75°F temperature increase at these different engine locations will produce test conditions of different severity relative to the temperature levels imposed on the engine hot section components. In addition, many European engines were validated to FAR 33 based on the equivalent level of safety of various JAR-E tests and analyses which do not directly correspond to the FAA engine overtemperature requirements. Despite these variations in test conditions, in-

service experience of all of these engines has validated the suitability of the rule relative to the substantiation of continued safe flight. However, to ensure standard application of the rule, specification of a single governing temperature location is necessary. Because of the variety of turbine engine configurations for which this rule is applicable to, only TIT will allow for consistent testing severity for all engine models.

All ACO's evaluating applicant's test plans for compliance with FAR 33.88 should ensure that TIT is specified as the governing temperature location from which to base the test temperature. For engine models in which TIT is not directly measured, analytical means may be used to extrapolate this temperature from the measured temperature.

Original signed by:
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